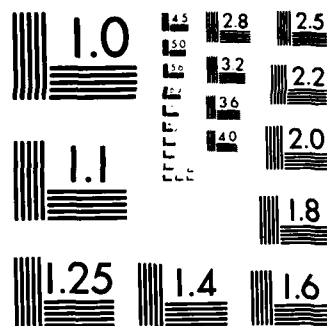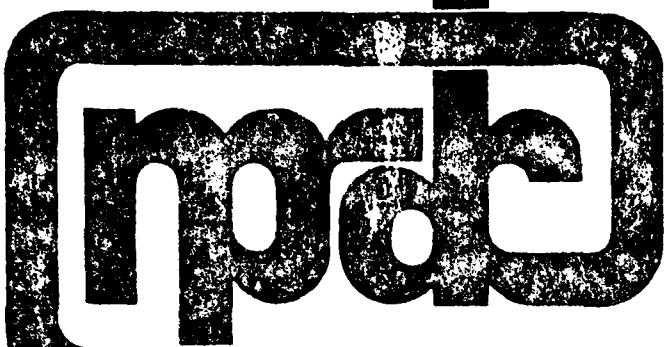MICROCOPY RESOLUTION TEST CHART

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NOTES ON REMEDIATION IN TRAINING

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NOTES ON REMEDIATION IN TRAINING

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FOREWORD

This research and development was conducted in support of Exploratory Development Task Area ZF55.522.002 (Methodology for the Development and Evaluation of Navy Training Programs) and Work Unit ZF55.522.002.03.33 (Practical Problems in the Implementation of Individualized Instruction) under the sponsorship of the Chief of Naval Education and Training.

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DONALD F. PARKER
Commanding Officer

iii

SUMMARY

Problem

Remediation of students who experience learning problems is needed in almost any training course and can take different forms. Several issues should be considered before a remedial approach is developed.

Objective

The objective of this paper is to clarify issues and alternatives in remediation and thereby assist in future course planning.

Approach

The ideas presented in this paper were developed in a study of the problems that arise in individualized instruction. Although the study focused on computer-managed instruction, these comments apply to traditional platform and laboratory instruction as well.

Conclusions

1. In planning remediation for Navy training courses, course developers should vary levels of mastery and remediation in accordance with the importance of the task to be taught and the probability that students will use their new skills and information to master later academic or job tasks.

2. Using improved motivational techniques could reduce the amount of remediation necessary in most training courses.

Recommendations

The following actions could reduce the need for remediation through effective course planning:

1. Include in each course only instructional materials that will help students develop skills and information they will use in later courses or on the job.

2. Apply different standards of mastery and remediation for material of different degrees of importance.

3. Establish enabling objectives within each course to facilitate learning of broader terminal objectives. Test students initially for their mastery of terminal objectives and, if indicated, remediate only after identifying specific deficiencies by testing for mastery of enabling objectives.

4. Conduct instructor in-service training emphasizing positive motivational techniques.

CONTENTS

NOTES ON REMEDIATION IN TRAINING

Introduction

Ideally, a training course contains only material that enables the student to transfer to his job the skills and knowledge he gains in the course, or to master one course topic using the information gained in studying an earlier topic. Unfortunately, few courses are as well organized for transfer as they should be. Course planners are not always able to determine whether information is essential, important, or merely interesting, and, consequently, they may include material from all three categories. When they try to develop remedial materials for students who do poorly in the course, they must ask themselves two questions: (1) Should students be held to the same standards of mastery for all course materials, since some materials may not be essential? (2) How, if varying standards are to be applied, are students to be remediated to meet these standards?

The following comments are intended to suggest some of the issues that course planners must consider in answering these questions. While these comments focus on individualized training courses, they are equally applicable to platform and laboratory instruction, since planners of these courses must resolve similar issues in selecting remedial measures.

General Approaches to Remediation

Remediation of students who experience learning problems is needed in almost any training course and can take different forms. Common remediation strategies include directing the student to restudy the course materials, sending him to some other resource that provides additional or more detailed information, or directing him to seek assistance from his Learning Supervisor/Instructor (LS/I). All three strategies are used in Navy Computer-managed Instruction (CMI), e.g., Basic Electricity and Electronics (BE/E), Avionics "A" School.

Other, less common remediation strategies include giving the student some prerequisite skill or knowledge, providing test feedback explaining the reasons for errors, or assigning alternate media for his study. Using alternate media, such as topic-specific audiovisuals, appears, in principle, to be an excellent strategy; but this option, in present Navy CMI courses, is limited to some non-specific, off-the-shelf materials, and to some in-house items that recite or repeat the printed information.

The relative merits of these strategies should be recognized. If more time is available to train students, remediation alternatives may not be necessary. Similarly, if LS/I-student ratios are high, less need exists for additional references or media because the LS/I can provide the remediation. At times of peak load, however, LS/I assistance provided to one student may mean time lost by other students waiting in line for help, and the additional printed or media resources available to students for self-study become more important.

The following pages will consider several remediation issues in detail.

Issues in Remediation

Range of Performance

A student's performance may be so poor that only restudy (or initial study in the case of pretest performance) will correct deficiency. At the other extreme, the student may miss a test item because he makes an error in marking the answer sheet. Neither situation calls for additional resources. An efficient way of remediating the second student might be for the computer to give him the correct answer and direct him to review if he still has a question, or to proceed to new material if he is no longer confused. Remediation strategies must be provided for students whose performance falls between these extremes.

Common Errors

Some topics or test items seem particularly troublesome, and for students who miss them, remediation might consist of a simple statement such as, "You may have (omitted) (confused) (misinterpreted) (neglected to) (other common error). Think about (appropriate corrective statement)." Nevertheless, commonly made errors suggest that the subject is so difficult, or the presentation so poor, that the instructional materials should be rewritten. For some off-the-shelf material, explanatory remediation still might be desirable. Also, pre-study instructions may be used to tell the students to look for certain points or avoid common pitfalls in the material.

Validation Levels

If the material is written to obtain a pass rate of 90 percent, a 50 percent score might indicate that the student ought to withdraw from the class rather than work through remedial materials. If the material is written for an initial 50 percent pass rate, however, the same score would mean that the student had learned what he should and he would continue to study. Unfortunately, course planners, at present, cannot use pass rate to select students for remediation, since none of the training materials currently available are validated to a specific pass rate, and arguments for and against a proposed pass rate can easily be developed.

The Value of Making Errors

Some training personnel contend that students should be allowed to make errors in school because they will make errors on the job, and they must be able to overcome them. There is no evidence to substantiate this claim, and, in any case, course planners should not use this argument to justify inadequate materials.

Level of Mastery

The level of mastery required in a course (which determines how thoroughly the students learn the material) should vary in accordance with different criteria. One such criterion is the importance of the task to be learned; the others all concern transfer of learning.

Critical Tasks. Level of mastery is easily established for critical tasks such as landing an aircraft on a carrier, or for items of verbal learning that must be remembered for years, often without being used (e.g., safety rules, emergency procedures). Careful evaluation and thorough remediation are clearly necessary for these tasks and items.

Background Information. The appropriate degree of mastery and remediation is not so easily determined for general background and prerequisite information, since experienced practitioners and training personnel disagree about what background information is appropriate for a given technology. When the value of the material is in question, the learning standards and remediation become ambiguous also.

For example, what is the appropriate level of mastery for concepts that enable the student to understand a principle but do not improve his competence on the job (e.g., the notion that electricity is the movement of unimaginable numbers of infinitesimal bits of energy)? How much effort should be devoted to remediation of students who do not immediately grasp the language and ideas of electron theory? The only criterion at present is that the concepts should be learned to a level of mastery that will permit their later use—but what is that use? A critical reading of requirements suggests that the only evident use for some concepts is in passing an advancement-in-rating exam. Traditionally, this has been a very important objective, perhaps called into question now only because of insistent demands for economy in training.

The criterion of transfer of learning might be used to select or reject topics and concepts for training, thereby ensuring that course materials would be applicable to other courses or job tasks. This idea will be developed further, below.

Background Information and Transfer of Training. One of the most important training tasks in the Navy is to prepare men for work in the propulsion engineering spaces of ships. "A" School courses covering approximately 35 propulsion engineering systems are considered preparatory for this assignment. The information presented in these courses presumably helps "A" School graduates to learn the tasks of the watch. Once aboard ship, graduates usually begin as Messengers, a duty that brings them into contact with every system in the engineroom and fireroom. They progress through several watch stations, learning the tasks and duties of each, and assuming more responsibility as they gain experience.

Whether they are able to transfer the information learned in "A" School to the tasks they learn aboard ship is difficult to say, although

opportunities for transfer can be recognized both at the specific item/skill and general concept levels. For example, at the specific level, pumps and valves are identical from the school to the ship, and at the very general levels principles of operation of the basic steam cycle do not change. If the student learns the equipment components and this cycle, he knows how fuel is converted to propeller thrust and he has some idea of what is going on mechanically and what personnel do at each of the work stations concerned with this process. The student can also transfer attitudes developed in "A" School; for example, if he feels comfortable with his understanding of the engine or fireroom systems, he may adapt to them much more quickly than he would if he lacked this background.

Unfortunately, identifying the opportunities for transfer of learning does not enable course planners to determine the appropriate level of mastery for a school. If the goal is to engender favorable student attitudes toward the assignment, does it matter if the student misses test items such as the viscosity of fuel oil, for example? Since he will learn his watch station duties aboard ship, does it matter if he fails a test item on the function of the warming up and securing check-off sheets for the main plant, or a question on the discharge of bilge water? Should he be remediated for such items?

The varied paths by which recruits become watch standers in the engine-room make it even more difficult to establish "A" School standards and remediation standards for these jobs. A substantial number of personnel who work in the propulsion engineering spaces do not go to "A" School; they receive only a brief apprenticeship or familiarization course at a Naval Training Center and then report aboard ship. Aboard some ships they have access to extensive libraries of training materials and systematically organized, carefully monitored classes as well as direct training at the watch station. Aboard other ships they serve an apprenticeship that is less carefully structured and supervised, although they still can become competent watch standers.

Similar conditions exist for other technical areas and give rise to the same questions about "A" School training. What should the standards be? How thorough should the remediation procedures be?

Enabling Objectives and Transfer of Training. It is easier to use transfer of learning within a course to establish levels of mastery and remediation. Transfer occurs when a student masters an enabling objective and then uses his new skills and information to master a more comprehensive terminal objective. The enabling objectives are established to facilitate further learning; the terminal objectives are the "real" objectives of the course. If the student satisfactorily performs the tasks specified in the terminal objectives, no need exists to test him further. If he does not perform satisfactorily, his mastery of the enabling objectives should be tested to identify his specific deficiencies. The same logic would suggest that the student's performance on any unit or topic whose successful performance requires the mastery of lesser tasks ought to be tested first, while his performance on part tasks would be tested as the first remedial step if he made errors on the major or final task. He would be referred to remedial study materials by his performance on the second test, not the first. Currently, this approach is not being used in individualized courses. Rather, students are tested for mastery of enabling objectives and remediated for each.

Applicational Transfer. LS/I's observe that some students who pass the written exams become lost when attempting lab exercises that require them to reason about and selectively apply the information they have learned earlier. Although this could be regarded as an instance of the enabling objective-terminal objective problem, it probably indicates a gap in the instructional materials; it suggests that the course writer omitted some important instruction concerning application of the material. All factual and conceptual information included in a course should be intended for later application, but the application does not come automatically, and writing for applicational transfer of learning is clearly one of the course writer's most important functions. Remediation should be to the 100 percent standard for applicational objectives.

Recurring Topics. Another transfer question concerns the recurrence of certain topics in a given course. Later learning may be either facilitated or frustrated depending upon the student's first encounter with a recurring topic. For example, the set of concepts, interrelationships, and interactions referred to as Ohm's Law recurs in the Basic Electricity and Electronics (BE/E) course at increasing levels of complexity. Probably 75 percent of the subject matter concerns Ohm's Law in one way or another, and the great majority of the students who fail the course have probably failed to grasp this concept. The need for careful remediation, especially of the first encounters with this topic, seems evident. In contrast, the "hand rules" for the direction of current, which cause difficulty for many students, have very little application in the BE/E course or any successor course, so far as this can be determined from discussion with practitioners. For topics of this sort, either a lower standard of learning or a more limited remediation might be acceptable.[1]

Retention and Transfer. Perhaps one of the most important issues concerning remediation involves the student's retention over periods of time of what he learned earlier. Much Navy CMI requires a 100 percent level of mastery because the student is supposed to retain and transfer the course material to his duty assignment. Nevertheless, if the students are tested two weeks after they complete their courses, most will have lower scores. In the face of this immediate decrement, some course planners assert that the 100-percent mastery criterion is justified because a brief refresher course would bring the students' scores back up to 100 percent. This is true for some, but not all, of the students; hence, a variable standard exists.

This issue relates to important questions of efficiency and effectiveness of all Navy training, not just CMI.

Size of Remedial Assignments

The student may be assigned large or small units for restudy. He should be assigned only the material he needs to overcome his errors, and not be required to repeat material selected arbitrarily. This demands that course planners possess considerable insight into subject-matter

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[1]The hand rules were deleted in a new BE/E course revision.

relationships and mental processes (Why, for example, do some, but not all, students make errors?). Unfortunately, such insights have not been systematized and published. At present, some planners merely instruct the student to restudy the lesson, and they may assign varying amounts of remedial material.

Number of Tries

Another unresolved question is how many tries the student should undertake on his own before asking his LS/I for help. Some courses specify two unsuccessful attempts, others three. Perhaps it would be more effective to direct the student to his LS/I if he makes an error on a retest. When there are few students in the course, the student might be directed to his LS/I after one failed remediation; when large numbers of students must be accommodated, and consequently waiting lines form at the LS/I's desk, it might be more cost-effective to have the student make a second pass through the material on his own.

Number of tries can also be considered in another context An effective remediation approach might be to teach students in technical ools that they are capable of digging out the answers to questions they will at on the job. Therefore, students ought to be encouraged to make ever rt to work through remedial materials without asking for help. It certa may not be asserted, however, that the way to develop self-reliance in students is to withhold LS/I assistance from them when they need it.

Learning Standards--Remediation Trade-off

It was noted above that some issues of remediation could be resolved by lowering the required learning standard. In practice, technical schools may adopt a straight-forward solution to the problem of desirable but not justifiable subject matter: they ask no test questions covering this material. Unfortunately, the students quickly become aware of these omissions and skip the topic. One possible answer to this dilemma might be to include test questions but use explanatory feedback for errors.

An Alternate Approach

The foregoing discussion assumes that students learn what the training method permits, but individual differences among the students are at least as significant as the method in determining levels of learning. Dutiful and interested students give many extra hours to study, review, analysis, and practice; others do only the minimum required work. It follows that enhancing student motivation may be an alternative to some remediation.

Many students enter their technical schools with a strong motive to learn. If they make good progress, and their progress is recognized, they experience satisfaction that is a strong incentive to continue their studies. LS/I's understand this and use a variety of tactics to give such incentives. One tactic is to mark "attaboys" on the daily progress report. Another is to commend the student after successful tests and lab exercises, and to provide diagnostic help if he fails. Many LS/I's go over the logic and procedures of difficult exercises before the student takes the test for this material, drawing out his knowledge by carefully sequenced questions. Some LS/I's remind students that they

6

are making good progress toward important personal and Navy goals. They
help students see that, by their work, they are following a tradition
of accomplishment and service honored by many before them, often includ-
ing relatives and friends. They point out to the students their increas-
ing capacity for self-directed achievement and responsibility. In ways
such as these, and by providing models as competent professionals, they
increase the students' satisfaction and commitment to their studies.

Some Suggestions

The Transfer Criterion

Encourage course developers to include only instructional material that will
help the student develop skills and information he can use on his job or in sub-
sequent academic work. Increase emphasis on transfer of learning as a criterion
for selecting course content. This will give course developers a method for
analyzing the knowledge required to perform the tasks of the job-task inventory.
Also, encourage course writers to think in terms of applications of the informa-
tion presented. They should tell the students the specific applications for
the materials they are studying, and provide any other instruction the students
may need to apply the material.

Levels of Mastery and Remediation

Accept different standards for material of different degrees of impor-
tance--100 percent for critical information and lower standards for back-
ground information. Require additional study for errors on critical
content but consider using explanatory feedback for background material.

Enabling and Terminal Objectives

Continue to test for 100 percent achievement on the terminal objec-
tives while developing diagnostic tests for the enabling objectives. This method
assumes that the student's performance on the tasks included in the terminal
objectives does in fact depend upon his knowledge of the materials in the
enabling objectives.

Student and LS/I Motivation

Conduct in-service training for LS/I's that emphasizes positive motiva-
tional techniques. Additionally, seek opportunities to recognize the
outstanding work of the LS/I's.

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